
Korea Nuclear Data Center Progress Report for 2022-2023



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01 Introduction

» KNDC

- Established in 1997 to start research on nuclear data in Korea (formerly, 'Nuclear Data Evaluation Lab.')
- Joined the International Network of NRDC in 2000

» Main tasks

- **Evaluation** and method development for nuclear reaction data
- Establishment of **processing and validation** system of nuclear reaction/covariance data
- **Measurement** of nuclear reaction data and establishment of measurement facility
- Production and validation of **atomic/molecular** collision data

01 Introduction

» Staff

- 13 staff members: 8 regular staffs, 2 post-retirement researchers, a post-doctoral researcher, and 2 Ph.D. students

Korea Nuclear Data Center (Head: D.H. Kim)

Evaluation

Y.-S. Cho
H.I. Kim

Measurement

T.-Y. Song
S.C. Yang
Y.-O. Lee

Processing/ Validation

D.H. Kim
J.H. Lee
C.-S. Gil
H.L. Hyun

Atomic/ Molecular

D.-H. Kwon
K.-B. Chai
H.W. Shin
C.M. Shin

02 Measurement Facility

» Existing facilities

Facility	Characteristics	Measurements
Cyclotron (KIRAMS)	<ul style="list-style-type: none">• p : 20- 50 MeV / 40 μA• d : 10- 25 MeV / 20 μA• α : 20- 50 MeV / 1 μA	<ul style="list-style-type: none">• Activation cross section
Proton Linear Accelerator (KOMAC, KAERI)	<ul style="list-style-type: none">• p : 20 & 100 MeV (linac)	<ul style="list-style-type: none">• Activation cross section
Cyclotron (Jeongeup, KAERI)	<ul style="list-style-type: none">• p : 30 MeV / 100 μA	<ul style="list-style-type: none">• Activation cross section

» Planned facilities

Facility	Characteristics	Status
Heavy-Ion Accelerator (NDPS, IBS)	<ul style="list-style-type: none">• Cyclotron (70 MeV proton)• SC linac (H ~ U, 200 MeV/u(U))• SC linac (d (49 MeV/u), p (83 MeV))	<ul style="list-style-type: none">• Installed all components in 2021• Performance tests in 2022• Beam commissioning and experiment in 2024

02 Measurement Facility

» NDPS of IBS

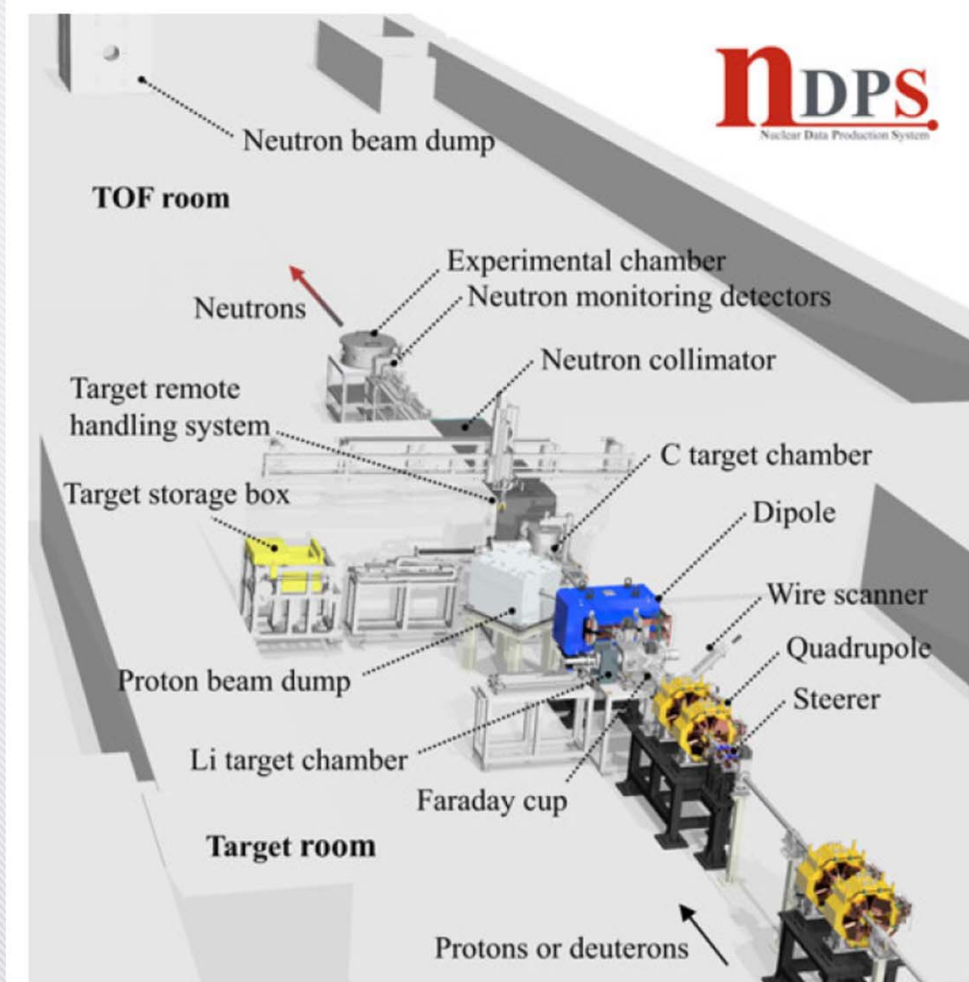
- Constructed Nuclear Data Production System (NDPS) in Institute for Basic Science (IBS) in cooperation with IBS, SKKU and UNIST in Korea
- Installed all the components for NDPS: neutron target system, collimator, beam dump, beam line, single bunch selector, detection system, etc.
- Carried out performance tests for some components
- The first beam commissioning and experiment with a proton beam are planned in 2024.
- To measure various nuclear reactions such as (n,f), (n, xn), etc. using TOF method in the range of 5 to 40 m

Primary beam	Beam energy [MeV/u]	Beam intensity [#/sec]	Beam power [kW]	Target			Neutrons [#/sec]
				Material	Density [g/cm ³]	Thickness [mm]	
d	48.9	7.68E+13	1.20	C	2.253	25	1.25E+13
p	82.7	9.74E+13	1.29	Li	0.534	2 ~ 7	9.21E+11

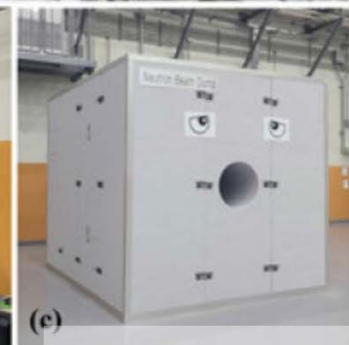
02 Measurement Facility

» NDPS of IBS

Schematic View of NDPS



Target Room



Neutron Detectors in TOF Room

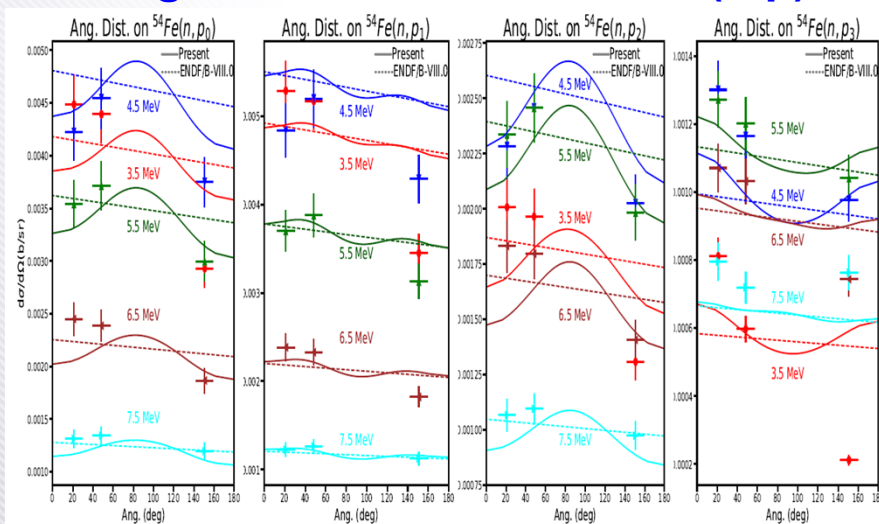
Neutron Beam Dump

03 Nuclear Data Activity

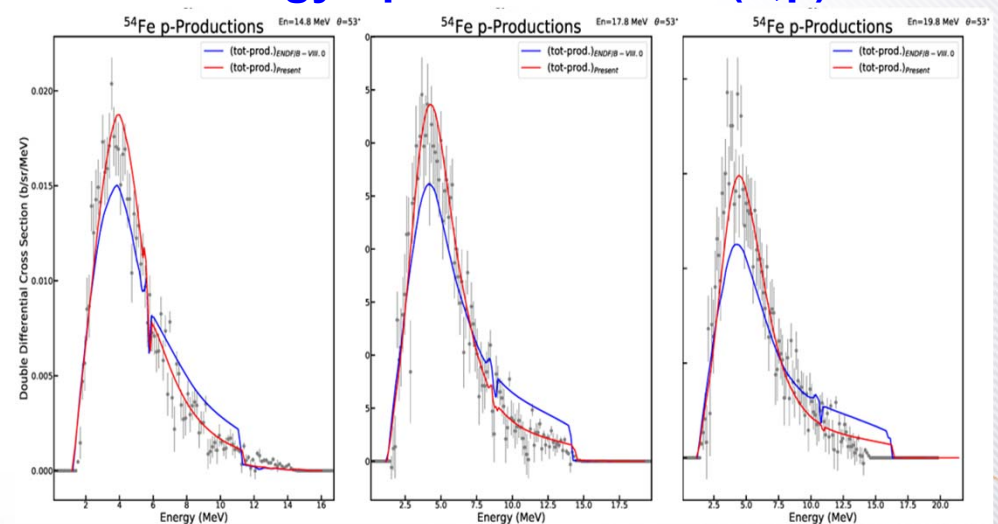
» Neutron-induced CP data update

- Completed in 2022 through I-NERI project with LANL
- Evaluate angular distributions and energy spectra for Fe, Ni, and Zn based on the experimental (n,p) and (n,a) reaction cross sections
- Predict angular distributions and energy spectra of (n,p) and (n,a) reactions for unmeasured nuclides, such as Cr, Mn, Co, Cu, and so on
- New evaluations have been submitted for ENDF/B-VIII.1- β 1.

Angular Distribution of $^{54}\text{Fe}(n,p)$



Energy Spectrum of $^{54}\text{Fe}(n,p)$



03 Nuclear Data Activity

» Neutron-induced CP data update

- List of 58 Nuclides Submitted for ENDF/B-VIII.1-β1 (2022.12.19)

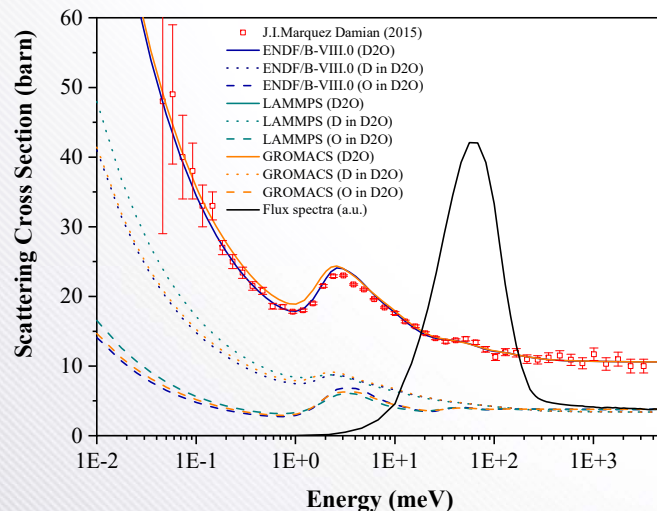
nucleus	# of discrete levels		nucleus	# of discrete levels		nucleus	# of discrete levels	
	p	a		p	a		p	a
Al-27	20	20	Cr-50	10	10	Zn-67	10	10
Si-28	14	16	Cr-51	10	10	Zn-68	8	10
Si-29	16	20	Cr-52	10	10	Zn-69	17	18
Si-30	6	12	Cr-53	10	10	Zn-70	1	1
Si-31	1	15	Cr-54	10	10	As-73	10	10
Si-32	1	1	Co-58	40	40	As-74	10	10
Cl-35	30	21	Co-59	10	10	Zr-90	12	9
Cl-36	16	32	Ni-58	10	10	Zr-91	6	40
Cl-37	10	6	Ni-59	10	10	Zr-92	1	40
K-39	10	10	Ni-60	10	10	Zr-93	17	27
K-40	10	10	Ni-61	10	10	Zr-94	10	40
K-41	10	10	Ni-62	10	10	Zr-95	16	9
Ti-46	10	10	Ni-63	26	10	Zr-96	3	10
Ti-47	10	10	Ni-64	10	10	Ag-107	10	10
Ti-48	10	10	Cu-63	10	10	Ag-109	31	2
Ti-49	10	10	Cu-64	40	40	Ta-180	10	10
Ti-50	10	10	Cu-65	10	10	Ta-181	10	10
V-49	40	40	Zn-64	10	10	Au-197	10	10
V-50	10	10	Zn-65	10	10			
V-51	10	10	Zn-66	10	10			

03 Nuclear Data Activity

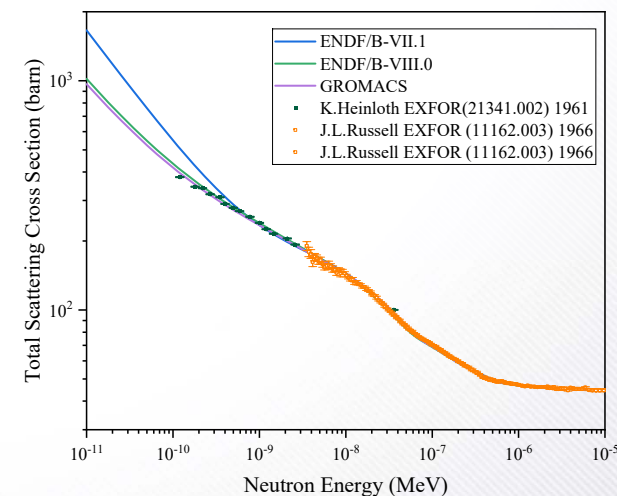
» TSL data production

- To produce, validate, and support TSL data of coolant/moderator materials for future advanced nuclear reactor R&Ds in Korea
- Preliminary TSL data of D₂O and H₂O
 - ✓ Frequency spectrum and/or Sköld correction factor obtained by MD simulations
 - ✓ GROMACS and LAMMPS codes with TIP4P/2005f or SPC/E water models

Scattering Cross Sections for D₂O



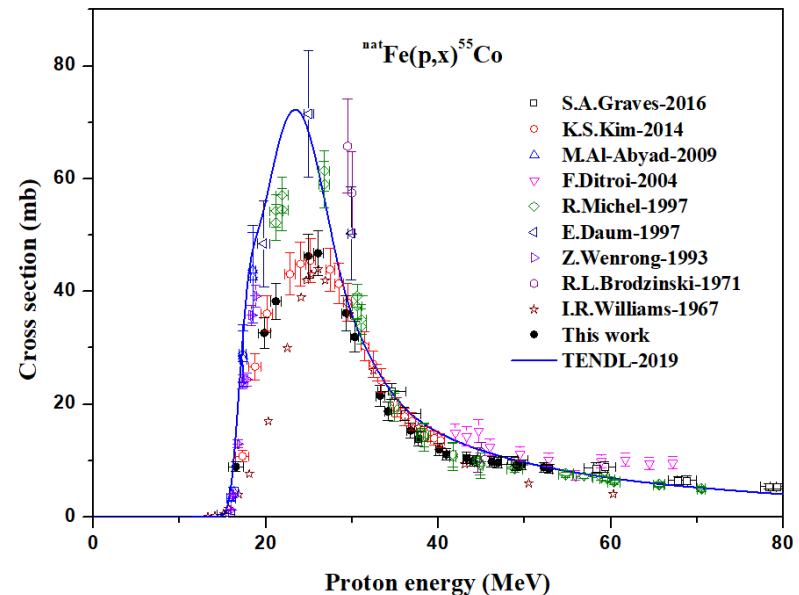
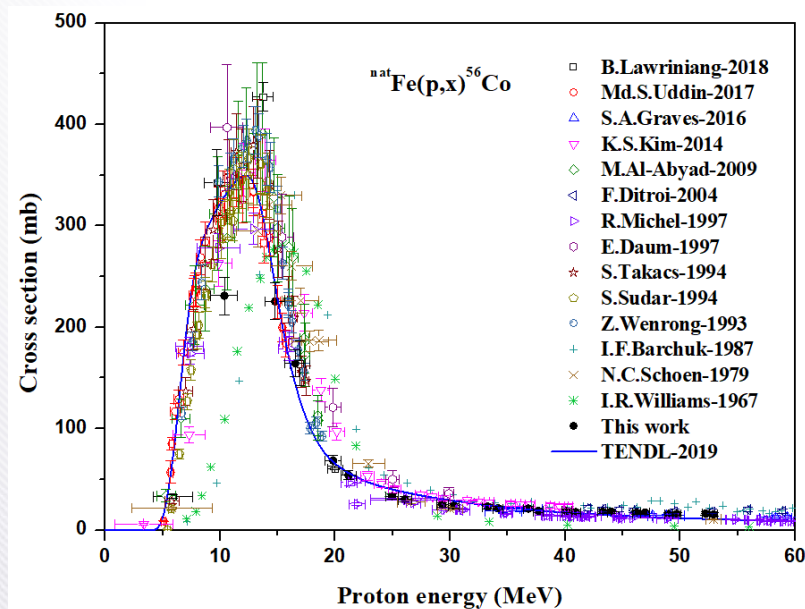
Scattering Cross Sections for H₂O



03 Nuclear Data Activity

» Proton-induced cross section data measurement

- Production cross sections of nat-Fe using the stacked-foil activation technique
- 57 MeV-proton beam at KOMAC facility
- Cross section data for 8 radionuclides



03 Nuclear Data Activity

» Event

- 11th Korea-Japan Joint Summer School on Accelerator and Beam Science, Nuclear Data, Radiation Engineering and Reactor Physics
 - ✓ Aug. 1~4, 2022 (Gyeongju, Korea)
 - ✓ Organized by KOMAC/KAERI and supported by KNDC
- Workshop on Low Energy RI Research
 - ✓ July 20~21, 2022 (Daejeon, Korea)
 - ✓ Organized by RAON of IBS
 - ✓ Introduce EXFOR and ND measurement activities of KNDC
- Reactor Physics Asia 2023 (RPHA23) - planned
 - ✓ Oct. 24~26, 2023 (Gyeongju, Korea)
 - ✓ Hosted by Reactor Physics and Computational Science Division of KNS
 - ✓ Cosponsored by Chinese Nuclear Society (CNS) and Atomic Energy Society of Japan (AESJ)



04 EXFOR Activity

» Responsibility

- Begin in 2009
- Compile nuclear reaction data in Korea under the guidance of IAEA/NDS
- Measurement data induced by neutron, charged particle, and photon

» Compilation status

- Number of entries in EXFOR: 8
 - ✓ Incident particle: proton
- Compiled and transmitted: 10
- Checking tool: www.jcprg.org/exfor/tool

04 EXFOR Activity

» Status

No.	TRANS	ENTRY	SUBENTRIES	SUBJECT	STATUS
1	D136	D7031	10	Proton	EXFOR
2	D136	D7032	4	Proton	EXFOR
3	D136	D7033	8	Proton	EXFOR
4	D137	D7034	3	Proton	EXFOR
5	D137	D7035	11	Proton	EXFOR
6	D137	D7036	3	Proton	EXFOR
7	D137	D7037	13	Proton	EXFOR
8	D137	D7038	10	Proton	EXFOR
9		D7039	4	Proton	Compiled
10		D7040	11	Proton	Compiled
11		D7041	7	Proton	Compiled
12		D7042	15	Proton	Compiled
13		D7043	14	Proton	Compiled
14		30851	2	Neutron	Compiled
15		30853	2	Neutron	Compiled
16		30854	3	Neutron	Compiled
17		30855	2	Neutron	Compiled
18		30856	12	Neutron	Compiled

04 EXFOR Activity

» D7036 Entry

- Article: Cross-sections of ^{100}gRh in $^{\text{nat}}\text{Pd}(p,x)$ reactions up to 42.61 MeV
- Isomeric Transition (IT) : ~98%
- Preliminary draft

```
REACTION (46-PD-0(P,X)45-RH-100-G,M+,SIG)
DECAY-DATA (45-RH-100-G,20.8HR,DG,539.51,0.806)
ANALYSIS 100Pd contribution subtracted.
```

- NDS comment
 - REACTION(SF4,SF5) –G,M+ could be omitted (IT~98%) for simplicity.
But there is no strict rule when IT<100% and final decision is up to you.
- Discussion with the corresponding author
- Selection: omit -G,M+

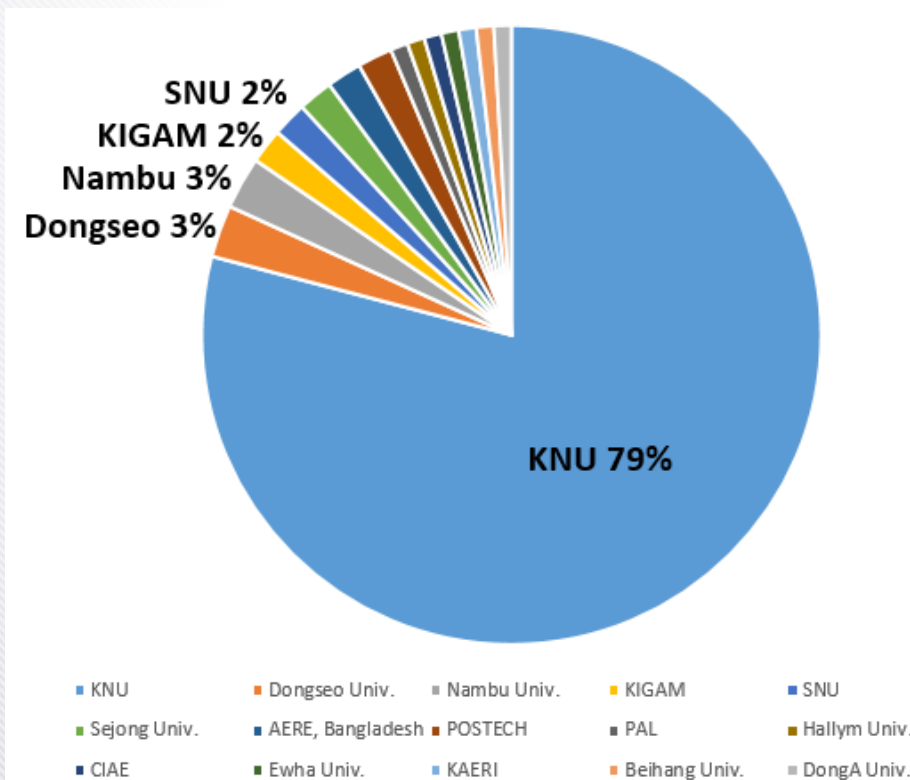
```
REACTION (46-PD-0(P,X)45-RH-100,,SIG)
DECAY-DATA (45-RH-100-G,20.8HR,DG,539.51,0.806)
ANALYSIS 100Pd contribution subtracted.
```

04 EXFOR Activity

» Contribution to EXFOR DB

- As of 2023, a total of 115 entries were registered.
- Compilation: ~8.2 per year

● Institute (corresponding author)



● Facility (for experimental work)

